





# The wake-up call WWA's response to the 2013 Front Range floods



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- Kevin Houck (CWCB)











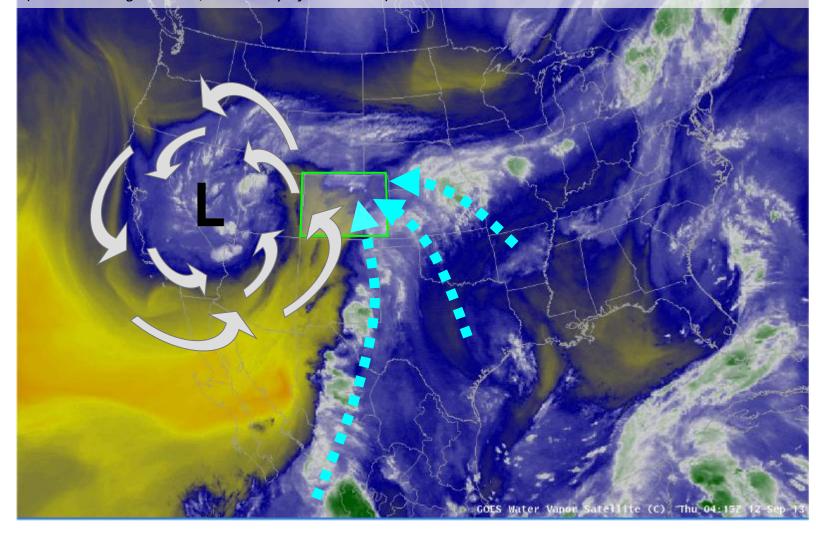




## The **Event**

## Water vapor and atmospheric circulation at 11:15 pm MDT, September 11, 2013.

(Satellite image: CIMSS, University of Wisconsin)



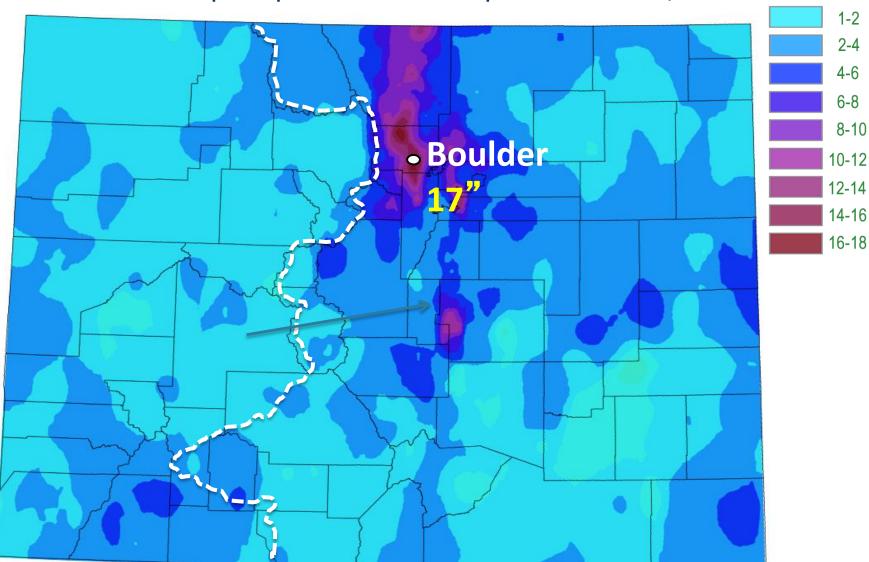
Precip., inches







### CoCoRAHS total precipitation from September 9–15, 2013









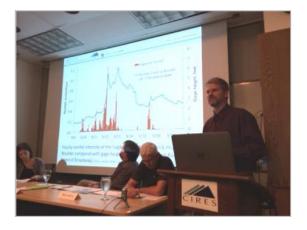




## WWA's rapid response - 10 days

- 4-page preliminary assessment
- Released at briefing and panel discussion attended by ~100 on-site and ~200 online
- Media coverage by local papers, public radio, The Weather Channel, CS Monitor, USA Today





### WWA's not-so-rapid outreach response

- 4-pager revised and reprinted in CSU's Colorado Water Dec. 2013 newsletter
- Presentations (2013-2014) to:
  - Colorado Association of Stormwater and Floodplain Managers
  - US Committee on Irrigation and Drainage
  - Ditch and Reservoir Company Alliance
  - Upper Colorado River Basin Annual Forum
  - City of Boulder Open Space & Mountain Parks staff
  - City of Boulder 1-year anniversary event (public)

#### September 2013 Front Range Flooding Event Weather, Hydrologic Impacts, Context of a Changing Climate, Implications

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theory rainfall during the flooding event was due to an unusual weather pattern characterized by a strong plume of implical moisture and upsigne winds. Alltime record or near-record precipitation data were collected at many sites along the Front Range. The cont forest burns likely enhanced local flooding and

isins, but overall, only had minor impact. milar precipitation events we occurred in the past, iscuring direct attribution climate change.

#### ntroduction

INTOBUCTION

A server and widespread flooding event along the Front Pange from Spepember 11-15 impaced, from soorth Fonneth Front Fange from Spepember 11-15 impaced, from soorth Fonneth Fonneth Greek, Beat Creek, Coal Creek, Fonder Creek, Leithmad Creek St. Vain in Greek Leithmad Creek St. Vain in Greek Leithmad Creek St. Vain in Greek Pander Foren and those flood flows gathered downsteam, there was seven flooding on the South Plane River and the Arkanssa River A. A sould 20 flooding countries were

impacted, from the Continental Durke to the Shirthan border, and from Publish to the Shirthan border, and from Publish to the Wyoming and from Publish to the Wyoming the Shirthan Shir

Following is an overview of the weather elements of this event, hydrological impacts, the contex of the changing climate, and implications for the assessment

#### The Weather

An unusually persist ent and moist weather pattern led to as sinishl totals from September 9: 15 that have come observed in only a handful of version on the From Range in the past centrary. The very heavy mindle was due to a combination of an annusually deep, moist flow and a total control of the pattern of consistently for each that moisture towards the Front Range.

First, a low-pressure system over t Great Basin pulled a strong plume of mon soonal tropical moisture from the Pacific Ocean off western Mexicos as the event progressed, the circulation brought yet more on the circulation brought yet more conone easterly and south assariny flow (Figure 1), also by a surface high over the Midwest This upslope flow drove the moisture against the foothlike, and a stalled from a cooss southern Colorado helped generate this and swinkil over an even image to the control of the cooking part entity believed in a stall of the cooking part entity is helped for this patternin place for almost one week.

one of the state o

All-stime record or mear-encord precipitation was recorded during the week across the Front Range. Seemed and mind thout (September 19 to September 13) exceeded 10 inches from Golden through Broulder into Laritere County, and also in Aurera (Tigger 2) and in 1D Faso County (out shown). Bouilder into Laritere County, and calso in 1874 and 1874 areas (Tigger 2) and in 1D Faso County (out shown). Bouilder in 1874 areas of the County out the County of the County o

THE WATER CENTER OF COLORADO STATE UNIVERSIT

## Catalyst for engagement with new stakeholders

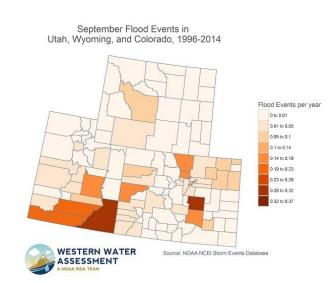
- Floodplain and stormwater planners and managers
- City, state, and federal emergency managers
- City, state, and federal hazard mitigation planners

## Catalyst for research – specific to 2013 event

- High-resolution weather modeling of 2013 event and similar extreme precip events (K. Mahoney, 2013 - ongoing)
- Paper on climate-change attribution of the 2013 event (M. Hoerling et al. 2014, BAMS)
- Survey of local residents and public officials on "surprise" associated with 2013 event (L. Dilling et al., 2013-14)

## Catalyst for research – broader scope

- Development of historical extreme events database for WWA region (CO, UT, WY) – 2013-ongoing
- Creation of new WWA research theme, "Extremes and Climate Risk Management" – 2014-ongoing
- Assessment of future projections of extreme precipitation events – 2015ongoing



## **Parting thoughts**

- Location strongly affected how we responded to this extreme event
- Climate-change attribution was not so important to our stakeholders
- We've spent more effort walking back the "1000-year event" meme



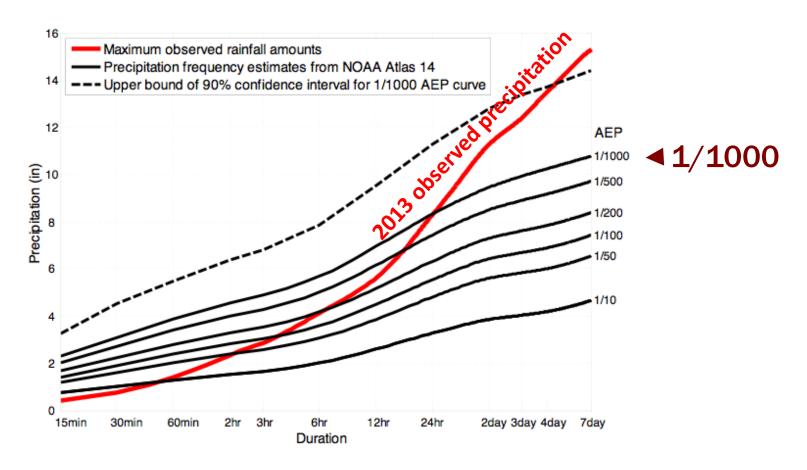








## Was it really a "1000-year rain" event? Unlikely.



NOAA Atlas 14 - Observed rainfall (red) at **Boulder** for different periods compared to corresponding *precipitation frequency estimates* (black).